SEQUENCE LISTING

<110> Matsui, Ikuo
Ishikawa, Kazuhiko
Ishida, Hiroyasu
Kosugi, Yoshitsugu

<120> THERMOPHILIC ENZYMES HAVING
BETA-GLYCOSIDASE ACTIVITY

<130> 11059/002001

<140> 09/369,735
<141> 1999-08-06

<160> 10

<170> FastSEQ for Windows Version 4.0

<210> 1
<211> 1269
<212> DNA
<213> Pyrococcus horikoshii

<220>
<221> CDS
<222> (1)...(1269)

<400> 1

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atg ccg ctg aaa ttc ccg gaa atg ttt ctc ttt ggt acc gca aca tca       48
Met Pro Leu Lys Phe Pro Glu Met Phe Leu Phe Gly Thr Ala Thr Ser
 1               5                  10                  15

tcc cat cag ata gag gga aat aat aga tgg aat gat tgg tgg tac tat       96
Ser His Gln Ile Glu Gly Asn Asn Arg Trp Asn Asp Trp Trp Tyr Tyr
            20                  25                  30

gag cag att gga aag ctc ccc tac aga tct ggt aag gct tgc aat cac      144
Glu Gln Ile Gly Lys Leu Pro Tyr Arg Ser Gly Lys Ala Cys Asn His
        35                  40                  45

tgg gaa ctt tac agg gat gat att cag cta atg acc agc ttg ggc tat      192
Trp Glu Leu Tyr Arg Asp Asp Ile Gln Leu Met Thr Ser Leu Gly Tyr
    50                  55                  60

aat gct tat agg ttc tcc ata gag tgg agc agg cta ttc cca gag gaa      240
Asn Ala Tyr Arg Phe Ser Ile Glu Trp Ser Arg Leu Phe Pro Glu Glu
65                  70                  75                  80

aat aaa ttt aat gaa gat gct ttc atg aaa tac cgg gag att ata gac      288
Asn Lys Phe Asn Glu Asp Ala Phe Met Lys Tyr Arg Glu Ile Ile Asp
                85                  90                  95

ttg tta ttg acg aga ggt ata act ccc ctg gtg acc cta cac cac ttt      336
Leu Leu Leu Thr Arg Gly Ile Thr Pro Leu Val Thr Leu His His Phe
            100                 105                 110

act agc cct ctc tgg ttc atg aag aaa ggt ggc ttc ctt agg gag gag      384
Thr Ser Pro Leu Trp Phe Met Lys Lys Gly Gly Phe Leu Arg Glu Glu
        115                 120                 125
```

```
aac cta aaa cat tgg gaa aag tac ata gaa aag gtt gct gag ctt tta      432
Asn Leu Lys His Trp Glu Lys Tyr Ile Glu Lys Val Ala Glu Leu Leu
    130                 135                 140

gaa aaa gtt aaa cta gta gct acc ttc aat gag ccg atg gta tac gta      480
Glu Lys Val Lys Leu Val Ala Thr Phe Asn Glu Pro Met Val Tyr Val
145                 150                 155                 160

atg atg gga tat cta acg gct tat tgg ccc cca ttc att agg agt cca      528
Met Met Gly Tyr Leu Thr Ala Tyr Trp Pro Pro Phe Ile Arg Ser Pro
                165                 170                 175

ttt aag gcc ttt aag gta gct gca aac ctg ctt aaa gct cac gca att      576
Phe Lys Ala Phe Lys Val Ala Ala Asn Leu Leu Lys Ala His Ala Ile
            180                 185                 190

gcc tat gaa ctt ctt cat ggg aaa ttc aaa gtt gga atc gta aag aat      624
Ala Tyr Glu Leu Leu His Gly Lys Phe Lys Val Gly Ile Val Lys Asn
        195                 200                 205

att ccc ata ata ctc cca gcg agt gac aag gag agg gat aga aaa gcc      672
Ile Pro Ile Ile Leu Pro Ala Ser Asp Lys Glu Arg Asp Arg Lys Ala
    210                 215                 220

gct gag aaa gct gat aat tta ttt aac tgg cac ttt ttg gat gcg ata      720
Ala Glu Lys Ala Asp Asn Leu Phe Asn Trp His Phe Leu Asp Ala Ile
225                 230                 235                 240

tgg agt ggg aaa tac aga ggg gta ttt aaa aca tat agg att ccc caa      768
Trp Ser Gly Lys Tyr Arg Gly Val Phe Lys Thr Tyr Arg Ile Pro Gln
                245                 250                 255

agt gac gca gat ttc att ggg gtt aac tat tac acg gcc agc gaa gta      816
Ser Asp Ala Asp Phe Ile Gly Val Asn Tyr Tyr Thr Ala Ser Glu Val
            260                 265                 270

agg cat act tgg aat cct tta aaa ttc ttc ttt gag gtg aaa tta gcg      864
Arg His Thr Trp Asn Pro Leu Lys Phe Phe Phe Glu Val Lys Leu Ala
        275                 280                 285

gat att agc gag agg aag act caa atg gga tgg agc gtt tat cca aaa      912
Asp Ile Ser Glu Arg Lys Thr Gln Met Gly Trp Ser Val Tyr Pro Lys
    290                 295                 300

gga ata tac atg gcc ctt aaa aaa gct tcc agg tat gga agg cct ctt      960
Gly Ile Tyr Met Ala Leu Lys Lys Ala Ser Arg Tyr Gly Arg Pro Leu
305                 310                 315                 320

tat att acg gaa aac gga ata gcg acg ctt gat gat gaa tgg aga gtg     1008
Tyr Ile Thr Glu Asn Gly Ile Ala Thr Leu Asp Asp Glu Trp Arg Val
                325                 330                 335

gaa ttc ata att caa cac ctc caa tac gtt cat aag gct atc gaa gac     1056
Glu Phe Ile Ile Gln His Leu Gln Tyr Val His Lys Ala Ile Glu Asp
            340                 345                 350

ggc ctg gat gta aga ggt tac ttc tat tgg tca ttt atg gat aac tac     1104
Gly Leu Asp Val Arg Gly Tyr Phe Tyr Trp Ser Phe Met Asp Asn Tyr
        355                 360                 365
```

```
gag tgg aaa gag ggg ttt ggg cct aga ttt ggc cta gtg gaa gtt gat     1152
Glu Trp Lys Glu Gly Phe Gly Pro Arg Phe Gly Leu Val Glu Val Asp
    370                 375                 380

tat caa acc ttc gag aga agg ccc agg aag agt gct tac gta tac gga     1200
Tyr Gln Thr Phe Glu Arg Arg Pro Arg Lys Ser Ala Tyr Val Tyr Gly
385                 390                 395                 400

gaa att gca aga agt aag gaa ata aag gat gag cta tta aag aga tat     1248
Glu Ile Ala Arg Ser Lys Glu Ile Lys Asp Glu Leu Leu Lys Arg Tyr
                405                 410                 415

ggc cta cca gaa ctt caa ctt                                        1269
Gly Leu Pro Glu Leu Gln Leu
            420
```

<210> 2
<211> 423
<212> PRT
<213> Pyrococcus horikoshii

<400> 2

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Met Pro Leu Lys Phe Pro Glu Met Phe Leu Phe Gly Thr Ala Thr Ser
 1               5                  10                  15
Ser His Gln Ile Glu Gly Asn Asn Arg Trp Asn Asp Trp Trp Tyr Tyr
            20                  25                  30
Glu Gln Ile Gly Lys Leu Pro Tyr Arg Ser Gly Lys Ala Cys Asn His
        35                  40                  45
Trp Glu Leu Tyr Arg Asp Asp Ile Gln Leu Met Thr Ser Leu Gly Tyr
    50                  55                  60
Asn Ala Tyr Arg Phe Ser Ile Glu Trp Ser Arg Leu Phe Pro Glu Glu
65                  70                  75                  80
Asn Lys Phe Asn Glu Asp Ala Phe Met Lys Tyr Arg Glu Ile Ile Asp
                85                  90                  95
Leu Leu Leu Thr Arg Gly Ile Thr Pro Leu Val Thr Leu His His Phe
            100                 105                 110
Thr Ser Pro Leu Trp Phe Met Lys Lys Gly Gly Phe Leu Arg Glu Glu
        115                 120                 125
Asn Leu Lys His Trp Glu Lys Tyr Ile Glu Lys Val Ala Glu Leu Leu
    130                 135                 140
Glu Lys Val Lys Leu Val Ala Thr Phe Asn Glu Pro Met Val Tyr Val
145                 150                 155                 160
Met Met Gly Tyr Leu Thr Ala Tyr Trp Pro Pro Phe Ile Arg Ser Pro
                165                 170                 175
Phe Lys Ala Phe Lys Val Ala Ala Asn Leu Leu Lys Ala His Ala Ile
            180                 185                 190
Ala Tyr Glu Leu Leu His Gly Lys Phe Lys Val Gly Ile Val Lys Asn
        195                 200                 205
Ile Pro Ile Ile Leu Pro Ala Ser Asp Lys Glu Arg Asp Arg Lys Ala
    210                 215                 220
Ala Glu Lys Ala Asp Asn Leu Phe Asn Trp His Phe Leu Asp Ala Ile
225                 230                 235                 240
Trp Ser Gly Lys Tyr Arg Gly Val Phe Lys Thr Tyr Arg Ile Pro Gln
                245                 250                 255
Ser Asp Ala Asp Phe Ile Gly Val Asn Tyr Tyr Thr Ala Ser Glu Val
            260                 265                 270
Arg His Thr Trp Asn Pro Leu Lys Phe Phe Phe Glu Val Lys Leu Ala
        275                 280                 285
Asp Ile Ser Glu Arg Lys Thr Gln Met Gly Trp Ser Val Tyr Pro Lys
    290                 295                 300
```

```
Gly Ile Tyr Met Ala Leu Lys Lys Ala Ser Arg Tyr Gly Arg Pro Leu
305                 310                 315                 320
Tyr Ile Thr Glu Asn Gly Ile Ala Thr Leu Asp Asp Glu Trp Arg Val
                325                 330                 335
Glu Phe Ile Ile Gln His Leu Gln Tyr Val His Lys Ala Ile Glu Asp
            340                 345                 350
Gly Leu Asp Val Arg Gly Tyr Phe Tyr Trp Ser Phe Met Asp Asn Tyr
        355                 360                 365
Glu Trp Lys Glu Gly Phe Gly Pro Arg Phe Gly Leu Val Glu Val Asp
    370                 375                 380
Tyr Gln Thr Phe Glu Arg Arg Pro Arg Lys Ser Ala Tyr Val Tyr Gly
385                 390                 395                 400
Glu Ile Ala Arg Ser Lys Glu Ile Lys Asp Glu Leu Leu Lys Arg Tyr
                405                 410                 415
Gly Leu Pro Glu Leu Gln Leu
            420
```

<210> 3
<211> 57
<212> DNA
<213> Artificial Sequence

<220>
<223> An upper primer designed to create the NdeI site.

<400> 3
taagaaggag atatacatat gccgctgaaa ttcccggaaa tgtttctctt tggtacc 57

<210> 4
<211> 46
<212> DNA
<213> Artificial Sequence

<220>
<223> A lower primer designed to create the BamHI site.

<400> 4
tttactgcag agaggatccc taatcctaaa gttgaagttc tggtag 46

<210> 5
<211> 423
<212> PRT
<213> Pyrococcus horikoshii

<400> 5

```
Met Pro Leu Lys Phe Pro Glu Met Phe Leu Phe Gly Thr Ala Thr Ser
 1               5                  10                  15
Ser Lys Cys Ile Glu Gly Asn Asn Arg Trp Asn Cys Trp Trp Tyr Tyr
            20                  25                  30
Glu Gln Ile Gly Lys Leu Pro Tyr Arg Ser Gly Lys Ala Cys Asn His
        35                  40                  45
Trp Glu Leu Tyr Arg Asp Asp Ile Gln Leu Met Thr Ser Leu Gly Tyr
    50                  55                  60
Asn Ala Tyr Arg Phe Ser Ile Glu Trp Ser Arg Leu Phe Pro Glu Glu
65                  70                  75                  80
Asn Lys Phe Met Glu Asp Ala Phe Met Lys Tyr Arg Glu Ile Ile Asp
                85                  90                  95
Leu Leu Leu Thr Phe Gly Ile Thr Pro Leu Val Thr Leu His His Phe
            100                 105                 110
Thr Ser Pro Leu Trp Phe Met Lys Lys Gly Gly Phe Leu Arg Glu Glu
        115                 120                 125
```

```
Asn Leu Lys His Trp Glu Lys Tyr Ile Glu Lys Val Ala Glu Leu Leu
    130                 135                 140
Glu Lys Val Lys Leu Val Ala Thr Phe Asn Glu Pro Met Val Tyr Val
145                 150                 155                 160
Met Met Gly Tyr Leu Thr Ala Tyr Trp Pro Pro Phe Ile Arg Ser Pro
                165                 170                 175
Phe Lys Ala Phe Lys Val Ala Ala Asn Leu Leu Lys Ala His Ala Ile
            180                 185                 190
Ala Tyr Glu Leu Leu His Gly Lys Phe Lys Val Gly Ile Val Lys Asn
        195                 200                 205
Ile Pro Ile Ile Leu Pro Ala Ser Asp Lys Glu Arg Asp Arg Lys Ala
    210                 215                 220
Ala Glu Lys Ala Asp Asn Leu Phe Asn Trp His Phe Leu Asp Ala Ile
225                 230                 235                 240
Trp Ser Gly Lys Tyr Arg Gly Val Phe Lys Thr Tyr Arg Ile Pro Gln
                245                 250                 255
Ser Asp Ala Asp Phe Ile Gly Met Asn Tyr Tyr Thr Ala Ser Glu Val
            260                 265                 270
Arg His Thr Trp Asn Pro Leu Lys Phe Phe Phe Glu Val Lys Leu Ala
        275                 280                 285
Asp Ile Ser Glu Arg Lys Thr Gln Met Gly Trp Ser Val Tyr Pro Lys
    290                 295                 300
Gly Ile Tyr Met Ala Leu Lys Lys Ala Ser Pro Tyr Gly Arg Pro Leu
305                 310                 315                 320
Tyr Ile Thr Glu Asn Gly Ile Ala Thr Leu Asp Asp Glu Trp Arg Val
                325                 330                 335
Glu Phe Ile Ile Gln His Leu Gln Tyr Val His Lys Ala Ile Glu Asp
            340                 345                 350
Gly Leu Asp Val Arg Gly Tyr Phe Tyr Trp Ser Phe Met Asp Asn Tyr
        355                 360                 365
Glu Trp Lys Glu Gly Phe Gly Pro Arg Phe Gly Leu Val Glu Val Asp
    370                 375                 380
Tyr Gln Thr Phe Glu Arg Arg Pro Arg Lys Ser Ala Tyr Val Tyr Gly
385                 390                 395                 400
Glu Ile Ala Arg Ser Lys Glu Ile Lys Asp Glu Leu Leu Lys Arg Tyr
                405                 410                 415
Gly Leu Pro Glu Leu Gln Leu
            420
```

<210> 6
<211> 483
<212> PRT
<213> Pyrococcus horikoshii

<400> 6

```
Met Lys Phe Tyr Trp Gly Val Val Gln Ser Ala Phe Gln Phe Glu Met
 1               5                  10                  15
Gly Asp Pro Tyr Arg Arg Asn Ile Asp Pro Arg Ser Asp Trp Trp Tyr
            20                  25                  30
Trp Val Arg Asp Pro Tyr Asn Ile Lys Asn Asp Leu Val Ser Gly Asp
        35                  40                  45
Leu Pro Glu Glu Gly Ile Asn Asn Tyr Glu Leu Tyr Glu Ile Asp His
    50                  55                  60
Arg Leu Ala Lys Glu Leu Gly Leu Asn Ala Tyr Gln Leu Thr Ile Glu
65                  70                  75                  80
Trp Ser Arg Ile Phe Pro Cys Pro Thr Phe Asn Val Glu Val Glu Phe
                85                  90                  95
Glu Arg Asp Asx Tyr Gly Leu Ile Lys Lys Val Lys Ile Glu Lys Glu
            100                 105                 110
His Leu Glu Glu Leu Asp Lys Leu Ala Asn Gln Lys Glu Val Arg His
        115                 120                 125
```

```
Tyr Leu Asn Val Leu Arg Asn Leu Lys Lys Leu Gly Phe Thr Thr Phe
    130                 135                 140
Val Thr Leu Asn His Gln Thr Asn Pro Ile Trp Ile His Asp Pro Ile
145                 150                 155                 160
Glu Thr Arg Gly Asn Phe Gln Lys Ala Arg Ala Pro Gly Trp Val Asp
                165                 170                 175
Glu Arg Thr Ile Ile Glu Phe Ala Lys Tyr Ala Ala Tyr Val Ala Trp
            180                 185                 190
Lys Phe Asp Asn Tyr Val Asp Tyr Trp Ser Thr Phe Asp Glu Pro Met
        195                 200                 205
Val Thr Ala Glu Leu Gly Tyr Leu Ala Pro Tyr Val Gly Trp Pro Pro
    210                 215                 220
Gly Ile Leu Asn Pro Ser Ala Ala Lys Lys Val Ile Ile Asn Gln Ile
225                 230                 235                 240
Val Ala His Ala Pro Ala Tyr Asp Ser Ile Lys Lys Phe Ser Ser Lys
                245                 250                 255
Pro Val Gly Val Ile Leu Asn Ile Ile Pro Ala Tyr Pro Leu Asp Pro
            260                 265                 270
Asn Asp Ser Lys Ser Val Arg Ala Ala Glu Asn Tyr Asp Leu Phe His
        275                 280                 285
Asn Arg Leu Phe Leu Glu Ala Val Asn Arg Gly Asn Val Asp Leu Asp
    290                 295                 300
Ile Thr Gly Glu Tyr Thr Lys Ile Pro His Ile Lys Arg Asn Asp Trp
305                 310                 315                 320
Ile Gly Asn Asn Tyr Tyr Thr Arg Glu Val Val Lys Tyr Val Glu Pro
                325                 330                 335
Lys Tyr Glu Glu Leu Pro Leu Ile Thr Phe Val Gly Val Glu Gly Tyr
            340                 345                 350
Gly Tyr Ser Gly Asn Pro Asn Ser Leu Ser Pro Asp Asn Asn Pro Thr
        355                 360                 365
Ser Asp Phe Gly Trp Glu Val Phe Pro Gln Gly Leu Tyr Asp Ser Thr
    370                 375                 380
Leu Glu Ala Ala Glu Tyr Asn Lys Glu Val Phe Ile Thr Glu Asn Gly
385                 390                 395                 400
Ile Ala Asp Ser Lys Asp Ile Leu Arg Pro Arg Tyr Ile Ile Asp His
                405                 410                 415
Val Asn Glu Val Lys Lys Leu Ile Glu Asn Gly Ile Lys Val Gly Gly
            420                 425                 430
Tyr Phe His Trp Ala Leu Thr Asp Asn Tyr Glu Trp Ala Met Gly Phe
        435                 440                 445
Lys Ile Arg Phe Gly Leu Tyr Glu Val Asp Leu Ile Thr Lys Glu Arg
    450                 455                 460
Ile Pro Arg Arg Arg Ser Val Glu Ile Tyr Lys Lys Ile Val Met Glu
465                 470                 475                 480
Gly Ile Glu
```

<210> 7
<211> 510
<212> PRT
<213> Pyrococcus furiosus

<400> 7

```
Met Phe Pro Glu Met Phe Leu Trp Gly Val Ala Gln Ser Gly Phe Gln
 1               5                  10                  15
Phe Glu Met Gly Asp Lys Leu Arg Arg Asn Ile Asp Thr Asn Thr Asp
            20                  25                  30
Trp Trp His Trp Val Arg Asp Lys Thr Asn Ile Glu Lys Gly Leu Val
        35                  40                  45
Ser Gly Asp Leu Pro Glu Glu Gly Ile Asn Asn Tyr Glu Leu Tyr Glu
    50                  55                  60
```

```
Lys Asp His Glu Ile Ala Arg Lys Leu Gly Leu Asn Ala Tyr Arg Ile
65                  70                  75                  80
Gly Ile Glu Trp Ser Arg Ile Phe Pro Trp Pro Thr Thr Phe Ile Asp
                85                  90                  95
Val Asp Tyr Ser Tyr Asn Glu Ser Tyr Asn Leu Ile Glu Asp Val Lys
            100                 105                 110
Ile Thr Lys Asp Thr Leu Glu Glu Leu Asp Glu Ile Ala Asn Lys Arg
        115                 120                 125
Glu Val Ala Tyr Tyr Arg Ser Val Ile Asn Ser Leu Arg Ser Lys Gly
    130                 135                 140
Phe Lys Val Ile Val Asn Leu Asn His Phe Thr Leu Pro Tyr Trp Asp
145                 150                 155                 160
His Asp Pro Ile Glu Ala Arg Glu Arg Ala Leu Thr Asn Lys Arg Asn
                165                 170                 175
Gly Trp Val Asn Pro Arg Thr Val Ile Glu Phe Ala Lys Tyr Ala Ala
            180                 185                 190
Tyr Ile Ala Tyr Lys Phe Gly Asp Ile Val Asp Met Trp Ser Thr Phe
        195                 200                 205
Asn Glu Pro Met Val Val Val Glu Leu Gly Tyr Leu Ala Pro Tyr Ser
    210                 215                 220
Gly Phe Pro Pro Gly Val Leu Asn Pro Glu Ala Ala Lys Leu Ala Ile
225                 230                 235                 240
Leu His Met Ile Asn Ala His Ala Leu Ala Tyr Arg Gln Ile Lys Lys
                245                 250                 255
Phe Asp Thr Glu Lys Ala Asp Lys Asp Ser Lys Glu Pro Ala Glu Val
            260                 265                 270
Gly Ile Ile Tyr Asn Asn Ile Gly Val Ala Tyr Pro Lys Asp Pro Asn
        275                 280                 285
Asp Ser Lys Asp Val Lys Ala Ala Glu Asn Asp Asn Phe Phe His Ser
    290                 295                 300
Gly Leu Phe Phe Glu Ala Ile His Lys Gly Lys Leu Asn Ile Glu Phe
305                 310                 315                 320
Asp Gly Glu Thr Phe Ile Asp Ala Pro Tyr Leu Lys Gly Asn Asp Trp
                325                 330                 335
Ile Gly Met Asn Tyr Tyr Thr Arg Glu Val Val Thr Tyr Gln Glu Pro
            340                 345                 350
Met Phe Pro Ser Ile Pro Leu Ile Thr Phe Lys Gly Val Gln Gly Tyr
        355                 360                 365
Gly Tyr Ala Cys Arg Pro Gly Thr Gln Ser Lys Asp Asp Arg Pro Val
    370                 375                 380
Ser Asp Ile Gly Trp Glu Leu Tyr Pro Glu Gly Met Tyr Asp Ser Ile
385                 390                 395                 400
Val Glu Ala His Lys Tyr Gly Val Pro Val Tyr Val Thr Glu Asn Gly
                405                 410                 415
Ile Ala Asp Ser Lys Asp Ile Leu Arg Pro Tyr Tyr Ile Ala Ser His
            420                 425                 430
Ile Lys Met Ile Glu Lys Ala Phe Glu Asp Gly Tyr Glu Val Lys Gly
        435                 440                 445
Tyr Phe His Trp Ala Leu Thr Asp Asn Phe Glu Trp Ala Leu Gly Phe
    450                 455                 460
Arg Met Arg Phe Gly Leu Tyr Glu Val Asn Leu Ile Thr Lys Glu Arg
465                 470                 475                 480
Ile Pro Arg Glu Lys Ser Val Ser Ile Phe Arg Glu Ile Val Ala Asn
                485                 490                 495
Asn Gly Val Thr Lys Lys Ile Glu Glu Glu Leu Leu Arg Gly
            500                 505                 510
```

<210> 8
<211> 472
<212> PRT
<213> Pyrococcus furiosus

<400> 8

```
Met Lys Phe Pro Lys Met Phe Met Phe Gly Tyr Ser Trp Ser Gly Pro
 1               5                  10                  15
Gln Phe Glu Met Gly Leu Pro Gly Ser Glu Val Glu Ser Asp Trp Trp
            20                  25                  30
Val Trp Val His Asp Lys Glu Asn Ile Ala Ser Gly Leu Val Ser Gly
        35                  40                  45
Asp Leu Pro Glu Asn Gly Pro Ala Tyr Trp His Ile Tyr Lys Gln Asp
    50                  55                  60
His Asp Ile Ala Glu Lys Leu Gly Met Asp Cys Ile Arg Gly Gly Ile
65                  70                  75                  80
Glu Trp Ala Arg Ile Phe Pro Lys Pro Thr Phe Asp Val Lys Val Asp
                85                  90                  95
Val Glu Lys Asp Glu Glu Gly Asn Ile Ile Ser Val Asp Val Pro Glu
            100                 105                 110
Ser Thr Ile Lys Glu Leu Glu Lys Ile Ala Asn Met Glu Ala Leu Glu
        115                 120                 125
His Tyr Arg Lys Ile Tyr Ser Asp Trp Lys Glu Pro Gly Lys Thr Phe
    130                 135                 140
Ile Leu Asn Leu Tyr His Trp Pro Leu Pro Leu Trp Ile His Asp Pro
145                 150                 155                 160
Ile Ala Val Arg Lys Leu Gly Pro Asp Arg Ala Pro Ala Gly Trp Leu
                165                 170                 175
Asp Glu Lys Thr Val Val Glu Phe Val Lys Phe Ala Ala Phe Val Ala
            180                 185                 190
Tyr His Leu Asp Asp Leu Val Asp Met Trp Ser Thr Met Met Glu Pro
        195                 200                 205
Met Val Val Tyr Asn Gln Gly Tyr Ile Asn Leu Arg Ser Gly Phe Pro
    210                 215                 220
Pro Gly Tyr Leu Ser Phe Glu Ala Ala Glu Lys Ala Lys Phe Asn Leu
225                 230                 235                 240
Ile Gln Ala His Ile Gly Ala Tyr Asp Ala Ile Lys Glu Tyr Ser Glu
                245                 250                 255
Lys Ser Val Gly Val Ile Tyr Ala Phe Ala Trp His Asp Pro Leu Ala
            260                 265                 270
Glu Glu Tyr Lys Asp Glu Val Glu Glu Ile Arg Lys Lys Asp Tyr Glu
        275                 280                 285
Phe Val Thr Ile Leu His Ser Lys Gly Lys Leu Asp Trp Ile Gly Met
    290                 295                 300
Asn Tyr Tyr Ser Arg Leu Val Tyr Gly Ala Lys Asp Gly His Leu Val
305                 310                 315                 320
Pro Leu Pro Gly Tyr Gly Phe Met Ser Glu Arg Gly Gly Phe Ala Lys
                325                 330                 335
Ser Gly Arg Pro Ala Ser Asp Phe Gly Trp Glu Met Tyr Pro Glu Gly
            340                 345                 350
Leu Glu Asn Leu Leu Lys Tyr Leu Asn Asn Ala Tyr Glu Leu Pro Met
        355                 360                 365
Ile Ile Thr Glu Asn Gly Met Ala Asp Ala Ala Asp Arg Tyr Arg Pro
    370                 375                 380
His Tyr Leu Val Ser His Leu Lys Ala Val Tyr Asn Ala Met Lys Glu
385                 390                 395                 400
Gly Ala Asp Val Arg Gly Tyr Leu His Trp Ser Leu Thr Asp Asn Tyr
                405                 410                 415
Glu Trp Ala Gln Gly Phe Arg Met Arg Phe Gly Leu Val Tyr Val Asp
            420                 425                 430
Phe Glu Thr Lys Lys Arg Tyr Leu Arg Pro Ser Ala Leu Val Phe Arg
        435                 440                 445
Glu Ile Ala Thr Gln Lys Glu Ile Pro Glu Glu Leu Ala His Leu Ala
    450                 455                 460
Asp Leu Lys Phe Val Thr Arg Lys
```

465 470

<210> 9
<211> 489
<212> PRT
<213> Sulfolobus solfataricus

<400> 9

```
Met Tyr Ser Phe Pro Asn Ser Phe Arg Phe Gly Trp Ser Gln Ala Gly
 1               5                  10                  15
Phe Gln Ser Glu Met Gly Thr Pro Gly Ser Glu Asp Pro Asn Thr Asp
            20                  25                  30
Trp Tyr Lys Trp Val His Asp Pro Glu Asn Met Ala Ala Gly Leu Val
        35                  40                  45
Ser Gly Asp Leu Pro Glu Asn Gly Pro Gly Tyr Trp Gly Met Tyr Lys
    50                  55                  60
Thr Phe His Asp Asn Ala Gln Lys Met Gly Leu Lys Ile Ala Arg Leu
65                  70                  75                  80
Asn Val Glu Trp Ser Arg Ile Phe Pro Asn Pro Leu Pro Arg Pro Gln
                85                  90                  95
Asn Phe Asp Glu Ser Lys Gln Asp Val Thr Glu Val Glu Ile Asn Glu
            100                 105                 110
Asn Glu Leu Lys Arg Leu Asp Glu Tyr Ala Asn Lys Asp Ala Leu Asn
        115                 120                 125
His Tyr Arg Glu Ile Phe Lys Asp Leu Lys Ser Pro Gly Leu Tyr Phe
    130                 135                 140
Ile Leu Asn Met Tyr His Trp Pro Leu Pro Leu Trp Leu His Asp Pro
145                 150                 155                 160
Ile Arg Val Arg Arg Gly Asp Phe Thr Gly Pro Ser Gly Trp Leu Ser
                165                 170                 175
Thr Arg Thr Val Tyr Glu Phe Ala Arg Phe Ser Ala Tyr Ile Ala Trp
            180                 185                 190
Lys Phe Asp Asp Leu Val Asp Glu Tyr Ser Thr Met Met Glu Pro Met
        195                 200                 205
Val Val Gly Gly Leu Gly Tyr Val Gly Val Lys Ser Gly Phe Pro Pro
    210                 215                 220
Gly Tyr Leu Ser Phe Glu Leu Ser Arg Arg His Met Tyr Asn Ile Ile
225                 230                 235                 240
Gln Ala His Ala Arg Ala Tyr Asp Gly Ile Lys Ser Val Ser Lys Lys
                245                 250                 255
Pro Val Gly Ile Ile Tyr Ala Asn Ser Ser Phe Gln Pro Leu Thr Asp
            260                 265                 270
Lys Asp Met Glu Ala Val Glu Met Ala Glu Asn Asp Asn Arg Trp Trp
        275                 280                 285
Phe Phe Asp Ala Ile Ile Arg Gly Glu Ile Thr Arg Gly Asn Glu Lys
    290                 295                 300
Ile Val Arg Asp Asp Leu Lys Gly Arg Leu Asp Trp Ile Gly Met Asn
305                 310                 315                 320
Tyr Tyr Thr Arg Thr Val Val Lys Arg Thr Glu Lys Gly Tyr Val Ser
                325                 330                 335
Leu Gly Gly Tyr Gly His Gly Cys Glu Arg Asn Ser Val Ser Leu Ala
            340                 345                 350
Gly Leu Pro Thr Ser Asp Phe Gly Trp Glu Phe Phe Pro Glu Gly Leu
        355                 360                 365
Tyr Asp Val Leu Thr Lys Tyr Trp Asn Arg Tyr His Leu Tyr Met Tyr
    370                 375                 380
Val Thr Glu Asn Gly Ile Ala Asp Asp Ala Asp Tyr Gln Arg Pro Tyr
385                 390                 395                 400
Tyr Leu Val Ser His Val Tyr Gln Val His Arg Ala Ile Asn Ser Gly
                405                 410                 415
Ala Asp Val Arg Gly Tyr Leu His Trp Ser Leu Ala Asp Asn Tyr Glu
```

```
            420                 425                 430
Trp Ala Ser Gly Phe Ser Met Arg Phe Gly Leu Leu Phe Val Asp Tyr
        435                 440                 445
Asn Thr Lys Arg Leu Tyr Trp Arg Pro Ser Ala Leu Val Tyr Arg Glu
    450                 455                 460
Ile Ala Thr Asn Cys Ala Ile Thr Asp Glu Ile Glu His Leu Asn Ser
465                 470                 475                 480
Val Pro Pro Val Lys Pro Leu Arg His
                485
```

<210> 10
<211> 285
<212> PRT
<213> Artificial Sequence

<220>
<223> Consensus

<400> 10

```
Met Phe Pro Glu Phe Gly Gln Ser Gly Phe Gln Phe Glu Met Gly Pro
 1               5                  10                  15
Asp Asp Trp Trp Trp Val Asp Asn Ile Gly Leu Val Ser Gly Asp Leu
            20                  25                  30
Pro Glu Gly Asn Trp Glu Leu Tyr Asp His Ala Lys Leu Gly Leu Asn
        35                  40                  45
Ala Tyr Arg Ile Glu Trp Ser Arg Ile Phe Pro Pro Thr Val Glu Ile
    50                  55                  60
Val Glu Leu Glu Leu Ala Asn Ala His Tyr Arg Ile Leu Lys Pro Gly
65                  70                  75                  80
Thr Ile Val Asn Leu His Thr Leu Pro Asp Trp His Asp Pro Ile Arg
                85                  90                  95
Gly Trp Leu Glu Arg Thr Val Glu Phe Ala Lys Tyr Ala Ala Tyr Val
            100                 105                 110
Ala Lys Phe Asp Asp Val Asp Trp Ser Thr Phe Asn Glu Pro Met Val
        115                 120                 125
Val Leu Gly Tyr Leu Tyr Ser Gly Phe Pro Pro Gly Leu Ser Pro Glu
    130                 135                 140
Ala Ala Lys Asn Ile Ala His Ala Ala Tyr Asp Ile Lys Ser Lys Pro
145                 150                 155                 160
Val Gly Ile Ile Tyr Asn Asp Pro Lys Asp Ala Ala Glu Phe Glu Ala
                165                 170                 175
Ile Gly Glu Pro Asp Trp Ile Gly Met Asn Tyr Tyr Thr Arg Val Val
            180                 185                 190
Glu Leu Pro Gly Tyr Gly Leu Ser Pro Ser Asp Phe Gly Trp Glu Tyr
        195                 200                 205
Arg Glu Gly Leu Tyr Asp Leu Ala Tyr Pro Tyr Ile Thr Glu Asn Gly
    210                 215                 220
Thr Ala Asp Asp Pro Pro Tyr Ile Ser His Val Lys Ala Ile Glu Gly
225                 230                 235                 240
Asp Val Pro Gly Tyr Phe His Trp Ser Leu Thr Asp Asn Tyr Glu Trp
                245                 250                 255
Ala Gly Glu Met Arg Glu Gly Leu Glu Val Asp Thr Lys Glu Arg Pro
            260                 265                 270
Arg Ser Ala Val Tyr Arg Glu Ile Ala Ile Glu Leu Arg
        275                 280                 285
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